Available online: http://journal.ipb.ac.id/index.php/jgizipangan
Accredited based on DGHE, Republic of Indonesia No.12/M/Kp/II/2015
ISSN 1978-1059 EISSN 2407-0920

J. Gizi Pangan, July 2019, 14(2):91-98
DOI: 10.25182/jgp.2019.14.2.91-98

Preference for Sago and Nutrient Intake among Communities Consuming Sago in Kepulauan Meranti District, Riau Province, Indonesia

Syartiwidya[1,2*], Drajat Martianto[2], Ahmad Sulaeman[2], Ikeu Tanziha[2], Rimbawan[2]
[1]Riau Province Food Security Council, Pekanbaru 28143, Indonesia
[2]Department of Community Nutrition, Faculty of Human Ecology, IPB University, Bogor 16880, Indonesia

ABSTRACT

This study aimed to analyse the preference for sago products and nutritional intake of the community consuming sago in Kepulauan Meranti District, Riau Province. A cross-sectional study was conducted and 181 adults was purposively selected subjects in Tebing Tinggi Timur Sub-district, Kepulauan Meranti District, Riau Province. The data obtained were subject characteristics, anthropometry, preferences for sago products, and nutritional intake from semi-quatitative food frequency questionnaire and food recall. The most preferred sago products out of 10 types of processed sago products were sago noodles (89.9%), sago lempeng (86.9%), and lemak sago (85.4%). Sago consumption frequencies among the subjects were mostly 'often' (39.2%) and 'quite often' (30.6%). The average amount of sago consumption was 173.7±88.3 g/day. The subject's average daily energy intake was 1864±468 kcal and the average protein intake was 48.4±21.7 g. The energy adequacy levels of subjects who consumed sago <140 g/day and ≥140 g/day were categorized as 'normal' (25.9% and 34.0% respectively). Meanwhile, the average level of protein adequacy were categorized as deficit (38.3% and 43.0% respectively). The carbohydrate adequacy levels were categorized as 'excessive' (80.2% and 71.0% respectively). The fat adequacy levels were categorized as 'excessive' (90.1% and 92.0% respectively). Sago noodles and lemak sago are two potential sago products to be developed as alternative carbohydrate sources due to their high frequency and preferability.

Keyword: food frequency, nutrient intake, preference, sago

INTRODUCTION

Consumption pattern is defined as the composition of food, including the type and amount of food, consumed per person per day in a given period. It also reflects a person's preference for food and is influenced by the type of consumption, the benefits of food for health, content, information on nutritional value, packaging size andshape, and price (Muljaningsih 2011; Rizki *et al*. 2013; Syafani *et al*. 2015). The consumption pattern consists of several components, among others, the amount (portion) of food, type of food, and eating frequency. Consumption preference shows the tendency of preference level and preference for various products influencing the consumption decisions based on the attributes of the product, namely, quality (taste, color, shape, price) and related frequency of consumption (Zainuddin *et al*. 2018)

Food diversity is a key element of a quality diet and is expected to increase adequate essential nutrient intake to improve health (Muslimatun & Wiradnyani 2016). The quality of food consumption of the Indonesian, in general, has not reached an ideal point. This lack is caused by the domination of carbohydrate food group, especially grains, while coupled with lack of vegetable and animal protein sources and lack of vegetables and fruits as fiber as well as vitamins and minerals sources (Food Security Council 2015). In Indonesia, rice is still the dominant source for carbohydrate with 98.8 kg/cap/year, compared to other sources, such as sago which is still low at 0.5 kg/cap/year (Food Security Agency 2018).

Bintoro (2016) reported that the area of sago in Indonesia has spread in the provinces of Papua, Maluku, Central Sulawesi, South Sulawesi, West Kalimantan, Jambi, and Riau, reaching 5.2 million ha or about 50% of the sago area in the world. Ironically, sago consumption as a source for carbohydrate in these areas is also low and has been decreasing overtime. One of such area is the sago-producing region of Riau Province which has an area of 82,713 ha. The largest area of sago production in the province

[*]**Corresponding author:** tel: +6281365541515, email: widyaipbgma2015@gmail.com

is in the Kepulauan Meranti District, which is 38,163 ha with a production of 284,873 tons of dried sago flour every year (Forestry and Plantation Office of Kepulauan Meranti District 2016).

Despite the lack of exact data for actual consumption pattern, people of the Kepulauan Meranti District still consume sago as their main staple. This happens especially in coastal area like Tebing Tinggi Timur Sub-district where there are many gardens and sago processing plants. The frequency of people consuming sago is still quite high due to various factors including economic factors, distance from the market area, and habits, which influence the preference for processed sago products.

In addition to its cultural importance, processed sago products also have many advantages over other commodities, i.e. low Glycemic Index (GI), high amylose content, and antioxidant content that is beneficial to health (Purwani 2014). Due to above mentioned properties, sago products have several health benefits as follows I) providing a filling effect, thus reducing food intake, II) preventing constipation and reducing the risk of colon cancer, and III) stabilizing glucose levels in the blood (have low GI) so that it is safer for people with diabetes mellitus. Hariyanto (2017) found that dose-response correlation of sago analog rice as a substitute for rice was equivalent to 50% of energy needs from carbohydrate sources for diabetics patients. The patients tended to decrease glucose by 10%, cholesterol level from 212 mg/dl to 200 mg/dl, and triglyceride level from 160 mg/ dl to 131 mg/dl during a 4 weeks treatment. The subject were feed with sago analog rice twice, with total of 110 g for female and 140 g for male. Wahjuningsih (2015) showed that rats treated with daily red sago analog rice had higher insulin-producing cells.

However, studies about preference for sago and nutritional intake of people who consume sago have not yet been found. Therefore, this study aimed to analyse the preference for sago products and nutritional intake of the community consuming sago in the Kepulauan Meranti District, Riau Province.

METHODS

Design, location, and time

This study used a cross-sectional design in five villages, those were Sungai Tohor, Tanjung Sari, Nipah Sendanu, Batin Suir, and Lalang Tanjung, in Tebing Tinggi Timur Sub-district, Kepulauan Meranti District, Riau Province. It was conducted from May to September 2017.

Sampling

The study involved 181 subjects who live in five villages in Tebing Tinggi Timur Sub-district, especially in the riverside area. The basic assumption was that the community consumed subtantial amount of sago due to the proximity to a sago refinery factory, thus the sago availability is quite high. The inclusion criteria for the subject selection were that subjects should have ever consumed sago, be in the ages of 35-80, not have serious illnesses or take certain medication, not be involved in other studies, and be willing to sign the informed consent. The research protocol was approved by the Research Ethics Committee in the ethical assessment of research involving human subjects at IPB University with the following approval number: 031/IT3.KEPMSM-IPB/SK/2017.

Data collection

Data collected in this study included subject characteristics (gender, age, occupation, education level, and family income/month), consumption (nutritional preference and intake), and anthropometry. The data collection methods for subject characteristics, consumption, and preferences for processed sago products were questionnaires and direct interview by enumerators. Data on the frequency of sago consumption was measured using Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ). Food intake was measured using the food recall 1x24 hours. Height was measured with GEA® microtoise made in Indonesia with 0.1 cm accuracy, weight was measured with CAMRY® EB digital scale 9374 made in China with a precision of 0.1 kg. The Body Mass Index (BMI) was calculated using the formula of weight (kg) divided by height square (m^2). The level of subject's preferences for processed sago products were measured using Likert Scale with a scale range of 1 to 5 (1=strongly dislike, 2=dislike, 3=quite like, 4=like, and 5=strongly like).

Data analysis

Data processing and analysis were performed with Microsoft Excel software and IBM SPSS Statistics version 22. Data were presented in descriptive statistics. Nutritional intake was analysed using Nutrisurvey version 2007. Subject grouping was based on the results of research by Hariyanto *et al*. (2017) which stated that sago consumption ≥140 g/day could reduce

blood glucose, cholesterol, and triglyceride levels in diabetic patients. The frequency of sago consumption was categorized into 4 categories, those are often (1x/day, >1x/day), quite often (3-6x/week), rarely (1-2x/week), and very rarely (1x/month and 2-3x/month). The BMI was categorized according to Basic Health Research (2013), consists of wasting (<18.5), normal (≥18.5-<24.9), overweight (≥25.0-<27.0), and obese (≥27.0).

The level of nutrient intake adequacy was obtained by comparing the nutrient intake and nutritional needs of subjects corrected with standard weight, gender, and nutritional needs based on the Indonesian Recommended Dietary Allowances (RDA) 2003. Adequacies percentage of energy and protein from RDA according to the Indonesian Ministry of Health (2005) were categorized as 1) severely deficient (<70%), 2) moderately deficient (70-79%), 3) mildly deficient (80-89%); 4) normal (90-119%); and 5) excessive (≥120%). Carbohydrate adequacy percentage of total energy was categorized as less (<50%), normal (50-65%), and excessive (>65%). The level of fat adequacy percentage of total energy according to WNPG (2012) was categorized as less (<15%), adequate (15-30%), and excessive (>30%). Adequacy of vitamins and minerals from RDA according to Gibson (2005) was categorized as less (<77%) and adequate (≥77%). Whereas fiber adequacy percentage from RDA (PERKENI 2011) was categorized as less (<25%) and adequate (≥25%).

The level of preference of the subjects was analysed using the Likert Scale. The number of questions to determine the subject's level of preference for processed sago products was 5 with a minimum score of 1 and a maximum score of 5. The highest score was sought by the formula Y=maximum score x number of subjects. The classification of interval was as follows: I=100/ Total Score (Likert). Meanwhile, the following formula was used to get the preference level: total score/highest score x 100. Criteria for the interpretation based on intervals were 1) 0%-9.99%=strongly dislike, 2) 20%-39.99%= dislike, 3) 40%-59.99%=quite like, 4) 60%-79.99%=like, and 5) 80%-100%=strongly like.

RESULTS AND DISCUSSION

Characteristic of subjects

Subject characteristics including gender, age, occupation, education, and BMI are presented in Table 1. The subjects in this study were mostly female (65.8%). More than half of the subjects (53.0%) were above 50 years old. Subjects who consumed more sago (<140 g/ day) tended to be older and most of the younger subjects consumed less sago. This is in line with Forestry and Plantation Office of Kepulauan Meranti District (2014), their observation results stating that sago consumption pattern has shifted. Sago was once a staple food, but now it is shifting into a distant food. However, it is still maintained by the community and supported by the regional government. This condition can be seen from sago starch factories or refineries and processed sago which are still commonly found. Zahari *et al*. (2011) also showed that the emergence of technological advances, social progress through economic factors, education and lifestyle levels directly contribute to the process of change, thereby reducing the ability of the younger generation to prepare their native ethnic foods, such as sago.

Table 1. Distribution of characteristic's subjects based on the demographics and anthropometric status

Characteristics	Sago consumption/day		Total (n=181)
	<140 g (n=81)	≥140 (n=100)	
	n(%)	n(%)	n(%)
Gender			
Male	26(32.1)	36(36.0)	62(34.3)
Female	55(64.9)	64(64.0)	119(65.8)
Age (years)			
<50	41(50.6)	44(44.0)	85(47.0)
≥50	40(49.4)	56(56.0)	96(53.0)
Education			
No education	21(25.9)	29(29.0)	50(27.6)
Elementary school	37(45.7)	49(49.0)	86(47.5)
Junior high school	9(11.1)	13(13.0)	22(12.2)
Senior high school	11(13.6)	6(6.0)	17(9.4)
Diploma	0(0)	1(1.0)	1(0.6)
Bachelor	3(3.7)	2(2.0)	5(2.8)
Occupation			
Civil servant	3(3.7)	3(3.0)	6(3.3)
Employee	3(3.7)	6(6.0)	9(5.0)
Farmer	22(27.2)	36(36.0)	58(32.1)
Farm workers	22(27.2)	18(18.0)	40(22.1)
Trade/services	8(9.9)	8(8.0)	16(8.8)
Housewife	23(28.4)	29(29.0)	52(28.7)
BMI category			
Wasting	8(7.4)	16(16.0)	24(13.3)
Normal	43(53.1)	53(53.0)	96(53.0)
Overweight	16(19.8)	15(15.0)	31(17.1)
Obese	16(19.8)	16(16.0)	32(17.7)

Almost half (47.5%) of the subjects had low education, only up to elementary school. The majority of subjects worked as farmers (32.0%). The two top occupations of most subjects in the group who consumed sago ≥140 g/day were farmers (36.0%) and housewifes (29.0%) while in the group who consumed sago <140 g/day were housewives (28.4%) and farmers as well as farm workers with 27.2% in proportion each.

The results of BMI measurements showed that most subjects (53%) in both groups were categorized as 'normal'. However, in the group that consumed <140 g/day, there were more subjects categorized as 'overweight' and 'obese'. Meanwhile, subjects who were categorized as 'wasting' were higher in the group that consumed sago ≥140 g/day.

According to Ruslie and Darmadi (2012), the BMI is influenced by food intake, physical activity, and gender. Unbalanced nutrition, such as high calories and meat fat intake, low intake of fruits and vegetables, can affect BMI, leading to be at risk of obesity (Sudikno *et al*. 2018). As for the high proportion of subjects who were wasting, some possible explanations are the fact that subjects in the group who consumed sago ≥140 g/day are over 50 years old. According to Kvamme *et al*. (2011), the elderlies are at risk of malnutrition. Body compositions of the elderly have shown that during weight loss, men lose more lean mass, whereas women lose more fat mass.

Preference for sago processed products

There were 10 types of sago processed products which were commonly found in Kepulauan Meranti District, Riau Province, i.e. sago noodles, sago vermicelli, sago lempeng (sago disc made from sago and grated coconut, eaten with fried anchovy), sempolet (sago porridge with shrimp, snails, squid or shellfish, and fern vegetables), rendang sago (sago shaped in small granules eaten with bananas), gobak (similar to sago plates but not shaped like plate), mutiara sago (sago in the form of granules cooked with sugar and coconut milk), kapurun (sago pulp eaten with fish curry), sesagon (sago in the form of grains with grated coconut), and lemak sago (sago in the form of granules made with the addition of coconut milk).

Subject preferences shows the choice of subjects on various products based on their level of preference (Syafani *et al*. 2015). The preference for sago products was also assesed based on the Likert Scale for each processed sago product. The level of preference of the subjects based on the Likert Scale is presented in Table 2. The calculation on the level of preference showed that seven out of ten products were categorized as 'strongly like' by the subjects and the other three products were categorized as 'like'. The score rank for 'strongly like' products is as follows: sago noodles (89.9%), sago (86.9%), lemak sago (85.4%), rendang sago (84.9%), gobak (84.4%), sempolet (82.7%), and sesagon (80.3%). These results indicate that processed sago products are generally favored by subjects in meeting their food needs both as a staple or distant food.

The frequency of sago consumption

The frequency of consumption is several meals a day including breakfast, lunch, dinner, and snack and it is one component in dietary pattern besides the type and the amount of food. The frequency of consumption is related to eating habits, how often someone consumes a kind of

Table 2. The level of preference for some sago processed products in Meranti Islands Regency, Riau Province

Sago processed food	Level of preference					Total score	Score of preference
	A (strongly like)	B (like)	C (quite like)	D (dislike)	E (strongly dislike)		
Sago noodles	108	58	12	3	-	814	89.9
Sago vermicelli	35	97	35	4	10	686	75.8
Sago lempeng	88	76	12	2	3	787	86.9
Sempolet	72	73	26	8	2	748	82.7
Rendang sago	78	70	24	6	3	769	84.9
Gobak	81	70	22	5	3	764	84.4
Mutiara sago	24	86	48	16	7	647	71.5
Kapurun	33	87	40	17	4	671	74.1
Sesagon	48	94	33	6	-	727	80.3
Lemak sago	72	90	15	4	-	773	85.4

Score: A=5, B=4, C=3, D=2, E=1

food and the amount of food consumed or eaten by each person in a day for a certain period of time.

The results showed that the majority of subjects (89.0%) had a habit of consuming sago for more than 10 years (91.2%). The majority of subjects consumed sago as a distant food (95.0%). It can be understood because the majority of subjects consume rice, that is easier to obtain without requiring advanced processing, as a staple food. Sago, on the other hand, requires further processing. For example, sago noodles must be sauteed with the addition of herbs and supplementary ingredients, such as vegetables, eggs, shrimp and others. Subjects generally get sago from stalls or markets (65.2%) in flour or processed forms, such as sago noodles, sago vermicelli, lemak sago, rendang sago, and various cakes.

The highest frequency of sago consumption by subjects was in the 'often' category (39.2%) followed by 'quite often' (30.6%). The frequency of sago consumption in the group consuming sago <140 g/day was categorized as 'often' (51.9%), while in the group that consumed sago ≥140 g/day was categorized as 'quite often' (34.0%). These results mean that the group that consumes sago less in quantity consumes sago more often. This result is related to the fact that they consume sago products as snacks, such as lemak sago and rendang sago. The average number of sago consumption by subjects per day was 173.7±88.3 g/day. In the group that consumed sago <140 g/day, the average sago consumed was 95.1±31.9 g/day, while in the group consuming sago ≥140 g/day, the average sago consumed was more than twice the quantity of the former group, which was 237.5±64.6 g/day.

The subjects distribution according to the consumption frequency of 10 types of processed sago products can be seen in Table 3. Three processed sago products in the 'often' category of consumption by the subjects in this study were lemak sago (22.7%), rendang sago (18.2%), and sago noodles (10.5%). Meanwhile, in the 'quite often' category, the top processed sago products consumed were lemak sago (20.4%), sago noodles (15.5%), lempeng sago, and rendang sago (13.8%).

Table 3. Consumption frequency of 10 types of processed sago

Types of products	Sago consumption frequency			
	Often	Quite often	Rarely	Very rarely
	n(%)	n(%)	n(%)	n(%)
Sago noodles	19(10.5)	28(15.5)	76(42.0)	58(32.0)
Sago vermicelli	2(1.1)	10(5.5)	25(13.8)	144(79.6)
Sago lempeng	18(9.9)	25(13.8)	41(22.7)	97(53.6)
Sempolet	9(5.0)	7(3.9)	28(15.5)	137(75.7)
Rendang sago	33(18.2)	25(13.8)	28(15.8)	95(52.5)
Gobak	8(4.4)	14(7.7)	25(13.8)	134(74.0)
Mutiara sago	2(1.1)	6(3.3)	8(4.4)	165(91.2)
Kapurun	5(2.8)	4(2.2)	8(4.4)	164(90.6)
Sesagon	15(8.3)	16(8.8)	16(8.8)	134(74.0)
Lemak sago	41(22.7)	37(20.4)	29(16.0)	74(40.9)

Nutritional intake

The nutritional intake is the number of nutrients that follows the dietary requirements and concerns the balance between food intake and physical activity, producing a good balance of energy and nutrition, wheres low levels of physical activity are a risk factor for fat mass gain (Yan *et al*. 2018; Westerterp 2010; Shook *et al*. 2015). Based on the calculation of nutrient intake, the average energy intake of the subjects in this study was 1,864±468 kcal, and the average protein intake was 48.4±21.7 g. The average level of energy adequacy of all subjects in this study was categorized as 'normal' (92.0%), but their level of protein adequacy was categorized as 'mildly deficient' (85.3%). The levels of adequacies of carbohydrates and fats were categorized as 'excessive' with percentages of 93.8% and 98.9% respectively (Table 4).

The energy adequacy levels of subjects who consumed sago <140 g/day and ≥140 g/day were categorized as 'normal' (25.9.0% and 34% respectively). Meanwhile, their average level of protein adequacy was categorized as 'severely deficient' (38.3% and 43.0% respectively). These results mean that the subjects who consumed sago were unable to fulfill protein intake from sago because sago is known to contain small amounts of protein, so consuming processed sago products should be complemented with protein source from other foods. Meanwhile, all this time sago is commonly consumed with dried fish that tend to be salted and have low protein nutrient.

Table 4. Average nutrient intake and level of adequacy according to sago consumption

Nutrient	Nutrient intake[b]	Adequacy level according to sago consumption per day	
	Mean±SD	<140 g (n=81)[a]	≥140 g (n=100)[a]
Energy (kcal)	1864±468		
Severe deficit		16(19.8)	26(26.0)
Moderate deficit		15(18.5)	14(14.0)
Mild deficite		14(17.3)	13(12.0)
Normal		21(25.9)	34(34.0)
Excessive		15(18.5)	13(13.0)
Protein (g)	48.4±21.7		
Severe deficit		31(38.3)	43(43.0)
Moderate deficit		10(12.3)	3(3.0)
Mild deficit		6(7.4)	8(8.0)
Normal		19(23.5)	29(29.0)
Excessive		15(18.5)	17(17.0)
Carbohydrates (g)	285±119		
Less		8(9.9)	16(16.0)
Normal		8(9.9)	13(13.0)
Excessive		65(80.2)	71(71.0)
Fat (g)	55±26		
Less		2(2.5)	3(3.0)
Normal		6(7.4)	5(5.0)
Excessive		73(90.1)	92(92.0)
Fiber (g)	8±5		
Less		47(58.0)	49(49.0)
Adequate		34(42.0)	51(51.0)
Vitamin A (RE)	656±614		
Less		40(49.4)	43(43.0)
Adequate		41(50.6)	57(57.0)
Vitamin C (mg)	33±32		
Less		69(85.2)	85(85.0)
Adequate		12(14.8)	15(15.0)
Sodium (mg)	723±744		
Less		64(79.0)	73(73.0)
Adequate		17(21.0)	27(27.0)
Calsium (mg)	349±348		
Less		69(85.2)	86(86.0)
Adequate		12(14.8)	14(14.0)
Phosphor (mg)	768±344		
Less		31(38.3)	19(19.0)
Adequate		50(61.7)	81(81.0)
Iron (mg)	6±5		
Less		75(92.6)	78(78.0)
Adequate		6(7.4)	22(22.0)

[a]n(%), [b]Data nutrient intake from total food consumption

The carbohydrate adequacy levels of the subjects who consumed sago <140 g/day and ≥140 g/day were categorized as 'excessive' (80.2% and 71.0% respectively). This result showed that the average carbohydrate adequacy of the subjects in this study was met from sago as carbohydrate source besides rice. This result was in line with the research of Amir *et al*. (2017) which stated that groups that consumed a lot of sago had higher carbohydrate intake. Carbohydrate in sago is equivalent to rice with more resistant starch so that it can become prebiotic for the intestine and facilitate digestion, besides that can reduce insulin resistance and blood glucose levels (Karim *et al*. 2008; Zhou *et al*. 2015). In line with that, Purwani (2014) stated that the amylose content in sago starch is higher than that in rice flour. The fat adequacy levels of subjects who consumed sago <140 g/day and ≥140 g/day were categorized as 'excessive' (90.1% and 92.0% respectively).

The level of fiber adequacy in the group that consumed sago ≥140 g/day was mostly categorized as 'adequate' (51.0%), whereas in the group consuming sago <140 g/day was mostly categorized as 'less' (58.0%). It can be explained by the fact that sago has 4.5% resistant starch contained in 100 g of sago noodles (Hariyanto 2017). According to Samsir (2013), resistant starch is an insoluble fiber, but physiologically, resistant starch has physiological properties of the soluble fiber. In line with the research of Kusnandar *et al*. (2015), resistant starch in sago can be used as a source of fiber in the body. Sago has a high fiber. Fiber in the digestive tract can inhibit the rate of food and enzyme activity so that the digestive process, especially starch, is slow and the blood glucose response will be lower (Arif *et al*. 2013). A prospective cohort study by Weickert and Pfeiffer (2018) consistently shows that there is an association between high dietary fiber intake (>25 g/day in women and >38 g/day in men) with a reduced risk of type 2 DM around 20-30%.

The adequacy levels of vitamin A and phosphorus in both groups of subjects were in adequate level. However, the intakes of vitamin C, sodium, calcium, phosphorus, and iron were still less. This was because subjects consumed fewer vegetables and fruit. Mahan and Raymond (2017) stated that vitamin C and mineral from foods are available as macronutrients are digested and absorbed across the mucosal layer, primarily in the small intestine. Many factors affect the bioavailability of vitamin and mineral, including the presence or absence of other specific nutrients, acid or alkaline, phytates and oxalates. The absorpsion of zinc is impaired disproportionately, increasing the amounts of magnesium, calcium and iron. This research was in line with research conducted by Nuromi and Amalia (2012) which stated that the level of adequacy of micronutrients is categorized as low because the subjects rarely consume fruits as a source of vitamin C, vegetables as a source

of fiber, or animal protein as a source of calcium and iron.

Several limitations of this study are 1) food consumption measured only once by food recall 1x24 hours, 2) measuring the frequency of sago consumption only for the previous week, and (3) the presence of recall bias in measuring food intake. More indepth research needs to be done on matters related to sago consumption preferences, calculation of energy density from processed sago products, and the contribution of energy from sago carbohydrates to the total energy intake so that more relationships will be obtained for each observed variable.

CONCLUSION

The frequency of sago consumption of the subjects was generally categorized as 'often' and 'quite often'. Subjects who consumed more sago were more likely to be older (>50 years) and undernourished while they were less likely to be overweight or obese. The preferred processed sago products were dominated by sago noodles and lemak sago. Meanwhile, processed sago products that were most often consumed were lemak sago, rendang sago, and sago noodles. The energy adequacy levels of subjects who consumed sago <140 g/day and ≥140 g/day were categorized as 'normal'. The average levels of protein adequacy of subjects were categorized as 'severely deficient'. The carbohydrate adequacy levels and the fat adequacy levels of the subjects were categorized as 'excessive'.

Suggestions that can be generated from this research are that lemak sago and sago noodles can be further developed to increase community income and regional foreign exchange through the development of local products.

ACKNOWLEDGEMENT

The authors would like to thank the Ministry of Research, Technology and Higher Education of the Republic of Indonesia for providing research funding through the National Strategy Research (STRANAS) scheme for this research which was a series of research in the dissertation of the author. The authors have no conflict of interest.

REFERENCES

Amir S, Bahar B, Abdullah T. 2017. Effect of sago consumption pattern on LDL and HDL on women 35-55 years North Luwu District. International Journal of Science and Healthcare Research 2(4):22-30.

Arif A, Budiyanto A. 2013. Glicemic Index of Foods and Its Affecting Factors. J Litbang Pert 32(2):91-99.

Bintoro HM. 2016. Sago for Indonesia's progress. Paper at Symposium and Workshop the Sago National. Bogor: November 9-10.

Food Security Agency. 2018. Directory of development of food consumption. Jakarta: Food Security Agency of the Ministry of Agriculture of the Republic of Indonesia.

Food Security Council. 2015. Strategic food and nutrition policies for 2015-2019. Jakarta: Food Security Agency of the Ministry of Agriculture of the Republic of Indonesia.

Forestry and PlantationAgency of Kepulauan Meranti District. 2016. Total Wilayah Sagu di Kepulauan Meranti tahun 2015. Riau Province: Forestry and Plantation Agency of Kepulauan Meranti District.

Drewnowski A, Specter SE. 2004. Poverty and obesity: The role of energy density and energy costs. Am J Clin Nutr 79(1):6-16.

Syamsir E. 2013. Pati resisten sebagai sumber serat fungsional. Food Review Indonesia. January 1, 2013 edition.

Hariyanto B, Agus TP, Y Marsono, Sri Budi W, Agus W, Purwa TC. 2017. Penggunaan Beras Sagu untuk Penderita Pradiabetes. Jurnal Pangan 26(2):1-10.

Karim AA, Pei-lang AT, Manan DMA, Zaidul ISM. 2008. Starch from the sago (*Metroxylon sagu*) palm tree-properties, prospects, and challenges as a new industrial source for food and other uses. Comprehensive Reviews In Food Science And Food Safety 7(3):215-228.

Kusnandar F, Hastuti PH, Samsir E. 2015. Sago-resistant starch results from acid hydrolysis and autoclave-cooling. J Tech and Food Industry 26(1):52-62.

Kvamme JM, Olsen JA, Florholmen J, Jacobsen BK. 2011. Risk of malnutrition and health-related quality of life in community-living elderly men and women: The Tromsø study. Qual Life Res 20(4):575-582.

Mahan LK, Raymond JL. 2017. Krause's food and the nutrition care process (14th ed.). Missouri: Elsevier.

Ministry of Health Republic of Indonesia. 2013. Indonesia basic health research 2013. Jakarta: Health Research and Development Agency.

Muljaningsih S. 2011. Preferensi konsumen dan produsen produk organik di Indonesia.

Wacana Jurnal Sosial dan Humaniora 14(4):1-5.

Muslimatun S, Wiradnyani LAA. 2016. Dietary diversity, animal source food consumption and linear growth among children aged 1-5 years in Bandung, Indonesia: a longitudinal observational study. Br J Nutr 116(1):27-35.

Murakami K, Tracy A, McCaffrey, Livingstone MBE. 2013. Associations of dietary glycaemic index and glycaemic load with food and nutrient intake and general and central obesity in British adults. Br J Nutr 110(11):2047-2057.

Nurohmi S, Amalia L. 2012. Pengetahuan gizi, aktivitas fisik, dan tingkat kecukupan gizi aktivis Badan Eksekutif Mahasiswa (BEM) IPB. J Gizi Pangan 7(3):151-156.

Patiware MA, Osozawa K, Hu B. 2016. An overview of the traditional use of sago for sago-based food industry in Indonesia. ICoA Conference Proceedings, 7-9 November 2015. 3(2016):119-124.

Purwani EY. 2014. Pati resistan serta perannya dalam penghambatan proliferasi dan induksi apoptosis sel kanker kolon. Indonesian Journal of Cancer 8(4):32-39.

Rizki DA, Munandar JM, Andrianto MS. 2013. Analisis persepsi konsumen dan strategi pemasaran beras analog. Jurnal Manajemen dan Organisasi (2):144-162.

Ruslie RH, Darmadi D. 2012. Logistics regression analysis for factors that affect adolescent nutrition status. Andalas Medical Magazine 36(1):Januari-Juni 2012.

Shook RP, Hand GA, Drenowatz C, Hebert JR, Paluch AE, Blundell JE, Hill JO, Katzmarzyk PT, Church TS, Blair SN. 2015. Low levels of physical activity are associated with dysregulation of energy intake and fat mass gain over 1 year. Am J Clin Nutr 102:1332-1338.

Sudikno S, Syarief H, Dwiriani CM, Riyadi H, Pradono J. 2018. Obesity risk factors among 25-65 years old adults in Bogor city, Indonesia: a prospective cohort study. J Gizi Pangan 13(2):55-62.

Syafani TS, Lestari DAH, Sayekti WD. 2015. Analisis preferensi, pola konsumsi, dan permintaan tiwul oleh konsumen rumah makan di provinsi Lampung. Jurnal Ilmu-ilmu Agribisnis 3(1):85-92.

Wahjuningsih SB, Marsono Y, Praseptiangga D, Haryanto B. 2016. Resistant starch content and glycaemic index of sago (*Metroxylon spp*) starch and red bean (*Phaseolus vulgaris*) based analogue rice. Pak J Nutr. 15(7):667-672.

Wahjuningsih SB, Haslina H, Marsono Y. 2018. Hypolipidaemic effects of high resistant starch sago and red bean flour-based analog rice on diabetic rats. Mater Sociomed 30(4):232-239.

Westerterp KR. 2010. Physical activity, food intake, and body weight regulation: Insights from doubly labeled water studies. Nutrition Reviews 68(3):148-154.

Weickert MO, Pfeiffer AFH. 2018. Impact of dietary fiber consumption on insulin resistance and the prevention of type 2 diabetes. J Nutr 148(1):7-12.

Yan Y, Drenowatz C, Hand GA, Shook RP, Hurley TG, Hebert JR, Blair SN. 2016. Is nutrient intake associated with physical activity levels in healthy young adults?. Pub Health Nutr 19(11):1983-1989.

Zahari MSM, Kamaruddin MSY, Kutut MZ. The Level of Alteration of Ethics Native Food: (A Case of Sarawak, Malaysia). Int J of Human Soc Scie Res 1(6):137-144.

Zainuddin MZ, Samdin S, Madjid R, Juharsah J. 2018. The role of product preferences in mediating the influence of product knowledge on customer decisions. iOSR Journal of Business and Management Science 20(8):84-92.

Zhou Z, Wang F, Ren X, Wang Y, Blanchard C. 2015. Resistant starch manipulated hyperglycemia/hyperlipidemia and related genes expression in diabetic rats. Int J Biol Macromol 75:316-321.

Zuhdy N, Ani LS, Utami NWA. 2015. Physical activity, diet and nutritional status of high school girls in North Denpasar. Public Health Archives and Preventive Medicine 3(1):96-103.